

**WHAT IS CLAIMED IS:**

- 1           1.     A process comprising:
  - 2               a)     exposing a chemical species to nanoparticles such that said chemical
  - 3               species adsorbs onto a surface of the nanoparticles as a chemical
  - 4               adsorbate;
  - 5               b)     irradiating the nanoparticles comprising the chemical adsorbate with
  - 6               radiation;
  - 7               c)     detecting altered photoluminescence properties of the nanoparticles
  - 8               comprising the chemical adsorbate; and
  - 9               d)     analyzing the altered photoluminescence properties by comparing to
  - 10              one or more pre-defined altered photoluminescence properties, to
  - 11              provide for an identifying of the chemical species.

- 1           2.     The process of claim 1, wherein the radiation comprises ultraviolet radiation.

- 1           3.     The process of claim 1, wherein the nanoparticles comprise quantum
- 2           confined nanoparticles.

- 1           4.     The process of claim 1, wherein the nanoparticles comprise silicon
- 2           nanoparticles.

- 1           5.     The process of claim 1, wherein the one or more pre-defined altered
- 2           photoluminescence properties are provided by exposing nanoparticles having initial
- 3           photoluminescence properties to one or more known chemical species.

- 1           6.     The process of claim 1, wherein the chemical species is selected from the
- 2           group consisting of toxins, carcinogens, mutagens, lachrymators, flammable species, nerve
- 3           agents, explosives, and combinations thereof.

1           7.     The process of claim 1, wherein the adsorption of a chemical species onto the  
2 surface of the nanoparticles comprises a reversible process.

1           8.     The process of claim 1, wherein the nanoparticles range in size from about 1  
2 nm to about 100 nm.

1           9.     The process of claim 1, wherein the nanoparticles are present in an aerosol.

1           10.    The process of claim 1, wherein the detecting the altered photoluminescence  
2 properties comprises utilizing a wavelength selective detector.

1           11.    The process of claim 1, wherein the analyzing the altered photoluminescence  
2 properties comprises utilizing a wavelength selective detector.

1           12.    The process of claim 1, wherein the detecting and analyzing the altered  
2 photoluminescence properties comprises utilizing a spectrometer.

1           13.    The process of claim 1, wherein the detecting and analyzing the altered  
2 photoluminescence properties comprises utilizing an optical filter.

1           14.    The process of claim 1, wherein the nanoparticles are silicon nanocrystals.

1           15.    The process of claim 1, further comprising determining a concentration of the  
2 chemical species.

1           16. A process comprising using nanoparticles as taggants for material  
2 identification.

1           17. The process of claim 16, wherein the material is selected from the group  
2 consisting of toxins, carcinogens, mutagens, lachrymators, flammable species, nerve agents,  
3 explosives, and combinations thereof.

1           18. The process of claim 16, wherein the taggants are used in anti-counterfeiting  
2 applications.

1           19. The process of claim 16, wherein the identification is based on properties  
2 unique to the nanoparticles.

1           20. The process of claim 19, wherein a unique property is photoluminescence.